A

Synopsis

on the Topic

"A study of optimization problems by using evolutionary Computational Approach"

(Submitted for the enrolment as a research scholar for the degree of Doctor in Mathematics in the LINGAYA'S VIDHYAPEETH)

Under the Supervision

Dr. BINAY KUMAR

BY

PRIYAVADA

Research scholar Department of Mathematics

School of Basic and Applied Sciences

LINGAYA'S VIDHYAPEETH Faridabad, Haryana

Introduction

Optimization is a important segment of human life, it is obtained from Latin word Optimus. It is a technique for maximising or minimising some function relative to problem in given circumstances. The given function allows comparison of the difference choices for finding the best result. We solve the optimization problems in two conditions maximizing and minimizing. There are two type of optimization problems Linear and non Linear.

Optimization problems are solved by two methods traditional and non-traditional. But in some cases the problem is not solved by traditional method in that case we shall use non- traditional methods. In this paper we will use the non-traditional method for the solution of optimisation problem. These are swarm based nature inspired problem in which we find the near optimal solution with the help of non- traditional method. Many swarm based optimisation problems are solved by using modern techniques like PSO, ACO, SMO, ABC, Bat Algorithm, Cuckoo Algorithm etc. The main aim of these problem is to reach at the target point. These modern techniques are computer based technique and solve the optimisation problem in efficient way. In this technique the problem is solved by step by step.

Literature Review

Genetic Algorithm

(1) Ravindra K Ahuja et. al (1997): Produced the excellent survey of GA, covers the history of GA and combinatorial problems are also solved. GA may be viewed as an extremely useful tool in an OR toolkit for that reason alone. (2) Angel Kuri-Morales (2013): Developed the comparative study of structurally different genetic algorithms. When we have a large set of unconstraint function then we use genetic algorithm. GA is also applicable to multidimensional problems. (3) Manoj Kumar et. al (2010): Introduction and various applications are discussed. Censor based robot path planning, image processing, gaming, real time system and shop scheduling are the application areas. High level languages and programming approaches are used for the solution.

Particle Swarm Optimization

(4) Soniya Lalwani (2018): PSO solved many high level computational complex research problems. PSO technique is most popular, based on swarm and solve the parallel PSO problems. (5) Harsh Maurya et. al (2019): The major concept of this paper is on inertia weight which are given to the velocities of the particles. What is the effect of this weight on optimal placement in different iterations? (6) Jad Shaari et. al (2019): Discussed the problem of unit commitment that is solved by using PSO technique. There are Many techniques which are used for these problems but still researcher are trying to find best technique and improve the efficiency. Most of the research papers are of multi-dimensional functions.

Ant Colony Optimization

(7) Diogo Alves et al (2010): Traffic dispersion routing problem and combinatorial problems are solved by using this technique and it is found that this technique is very best technique. Two principles of Wardrop's are used This technique provided the best result in Singapore

expressway network problem. (8) Albert Viseras et al (2016): There are some problems regarding I rapidly exploring random tree (RRT's method) in this paper and solution of these problems are discussed. (9) Benchi. Khi. Loubna et al (2017): Industrial vision constitutes and qualify control problem are discussed, find an ACO based model. Some applications of image processing are presented in to two issues.

Artificial Bee colony algorithm

(10) Emrah Hancer, et al (2015): Produced binary based algorithm and use of advanced similarity scheme for feature selection. The main purpose of this paper is to propose a new variant ABC algorithm for feature selection. The second aim is to demonstrate a comprehensive comparative study for the future studies of researcher. (11) Dervis Karaboga, Bohriye Basturk (2007): A powerful optimization technique is introduced by Dervis Karaboga and compared it with some other algorithms and found that this technique has good ability to get out of a local minimum. The result showed that ABC outperforms the other algorithm. GA and ABC techniques were applied on five high dimensional multimodality problems.

Spider Monkey Optimization

(12) Jagdish Chand Bansal et al (2014): Developed the numerical optimisation with the help of SMO. It is a interesting area for the researcher in the field of optimisation. Many simulating algorithms are developed by the researcher like ants, honeybee, fishes' birds etc. and their finding. This paper proposed a new optimisation method that is modelling the social behaviour of spider monkeys. (13) Harish Sharma et al (2019): Throw a light on swarm intelligence based algorithm and discuss all the details of SMO. There are two main phases which help in exploitation and LLDP and GLDP help in exploration of the search space. SMO has a great potential to be an efficient optimizer. SMO is applied for complex optimization problems. SMO technique solve many engineering optimization problems.

Optimization Problems

There are many optimization problems like bound constrained, combinatorial, constrained, continuous, discrete, single and multi-objective optimization problems, global optimization problems, deterministic and stochastic optimization problems. These optimization problems are used in different areas. Some common implementation in optimization techniques like minimal cost, maximal profit, minimal error, optimal design. The optimisation technique is used everywhere from engineering design to financial market and also in our daily life activities. Optimization techniques play a major role in operational research as well as in strategic decision making in business.

There are three main part of any optimization problems like an objective function, a set of variables and a set of constraints.

Objective Function: In this function we want to maximise or minimise value of the function depending upon problem. For example, in the financial problem we want to maximise profit and minimise risk.

Set of variables A set of variables affect the value of the optimization function.

A set of Constraints The variable can take certain values and they cannot take other vales depending on the constraints. There are several type of optimization problem which can be solve by different methods and techniques.

In this paper we will use modern techniques for solving optimization problems speciality multimodality problems. Traditional techniques generally fail to solve such large scale problems. Traditional techniques often fail to solve optimization problems that have many local optima. To overcome these problems there is need to use best optimization techniques that are known as modern techniques. As this paper is mainly about the study of optimization problems by using evolution techniques such as Genetic Algorithm, PSO, ACO, SMO. In fact, quite a significant number algorithm in optimization problem are primarily metaheuristics.

These evolutionary techniques are used to solve linear non-linear different and non-different optimization problems. Although there are various optimization methods are used for optimization problems. But from modern techniques we get the best result.

Methods and Techniques

Here we will use modern techniques for the solution of optimization techniques. These techniques are:

Genetic Algorithm

Genetic algorithm is a evolutionary technique introduced by professor Johan Holland in 1960s and 1970s. It is inspired by Charles Darwin theory of natural selection. Dr Johan Holland developed the theoretical framework for applying genetic algorithm. GA is typically applied to discrete optimization algorithm. GA is used to find near optimal solution to difficult research problem. Three operator's initialization, crossover and mutation are used for best result.

Particle Swarm Optimization

PSO is swarm based optimization technique was first suggested by James Kennedy in 1995 who is a social psychologist. It was started in social modelling and closely related to the graphic animation of flocks. It is inspired by the social behaviour of bird flocking and fish schooling. It is a step by step solution of any problem and update the position and velocity of particles after every iteration.

Ant Colony Optimization

ACO mimics the behaviour of real ants and developed by Marco Dorigo in 1991 during his Ph.D. thesis. Goss et al 1989, Deneuborg et al (1990) experiment with argentine ants. In this technique ants start moving randomly from their nest to the food source and then these ants return to the nest lying a pheromone trail. All the ants then follow shortest path with the help of deposited pheromone on the path. TSP is the best example of ACO.

Artificial Bee Colony Optimization

This is swarm based metaheuristic algorithm and one of the most recently defined algorithm by Dervis Karaboga in 2005. Dervis Karaboga in 2005 with the research group members studied on ABC algorithm and its applications to real world problem. First conference paper is published in 2006.ABC is inspired by the natural honey bees and use three main phases employed bees phase, onlooker bees phase and scout bees phase.

Spider Monkey Optimization

SMO is population based global optimization algorithm proposed by associate professor of south Asian university Delhi J.C Bansal in 2014. SMO Inspired by the social behaviour of spider monkeys and works in fission-fusion social structure. It is swarm based new algorithm and use six phases. Female monkey is the leader in every group and subgroup.

Conclusion

We will present commonly used practical problems which are in essence optimization problem. There are two optimization techniques classical and evolutionary to solve the optimization problem. We will present evolutionary optimization procedure. Optimization problem like complex, non-linear and multi-dimensional making the classical optimization procedure inadequate to be used with any reliability and confidence. Evolutionary techniques are different from classical optimization method in many ways1). Evolutionary algorithm is free from derivative 2) These modern techniques work with a set of solutions. There are many evolutionary techniques which are used in optimization problems. in this paper we will use five techniques GA, PSO, ACO, SMO and ABC for the solution of optimization problem.

References:

1. Ravindra K Ahuja, James B. Orlin (1997). Developing fitter in Genetics Algorithm. Informs journal on Computing 9(3): 251-253. Doi.Org/101287/ijoc.9.3.251.
2. Angel kuri Morales and Edwin Aldana-Bobadilla (2015). The best Genetic Algorithm IA Comparative study of structurally different genetic algorithms.
3. Manoj Kumar, Mohammad Husian, Naveen Upreti & Deepti Gupta. International Journal of Information Technology and Knowledge Management: July-December 2010, Volume 2, No. 2, pp.451-454.
4. Soniya Lalwani, Harsh Sharma, Suresh Chandra Satapathi, Kusum Deep and Jagdish Chand Bansal 2018. A survey on Parallel particle swarm optimisation algorithm. Arabian Journal for Science and Engineering. Doi.org10.1007/13369018-03713-6.
5. Harsh Maurya, Vivek kumar Bohra, Nidhi Singh Pal and Vikas Singh Bhadoria 2019, in Effect of Inertia weight of PSO on optimal placement of DG. IOP Conf. Series: Materials Science and Engineering 594 (2019) 012011 doi: 10.1088/1757899X/594/1/012011.
6. Jad shaari, Neyre Tekbiyik- Erosi and Mustafa Dagbasi (2019): The state of art in Particle swarm Optimisation based unit commitment: A review. Processes 2019,7,333; doi:10.3390/pr7100733.
7. Alberto Viseras, Rafel Ortiz Losada and Louis Merino (2016), Planning with Ants: Efficient path planning with rapidly exploring random trees and ant colony optimisation. International Journal of Advanced robotic system. DOI: 10.1177/1729881416664078.
8. Diogo Alves, Jelmer Van Ast, Zhe Cong, Bart D Schutter, and Robert Babuska (2010). Ant Colony Optimisation for traffic dispersion routing, Proceeding of the

13th International IEEE conference on ITSC 2010, Madeira Island, Portugal, PP.683-688, September 2010.

9. Benchikhhi Loubana, Sadgal Mohamed, Elfazziki Aziz and Mansouri Fatima Ezzahra (2017) in An Ant colony based model to optimise parameters in Industrial vision. ELCVIA ISSN:1577-5097 published by computer vision center. DOI: org/10.5565/rev/elvcia.957.
10. Emrah Hancer, Bing Xue, Dervis Karaboga & Mengjie zhang 2015. A binary ABC algorithm based on advanced similarity scheme for future selection. http://dx.doi.org/10.1016/j.asoc.2015.07.023.
11. Dervis Karaboga and Bahriye Basturk (2007). A powerful and efficient algorithm for numerical function optimization: Artificial Bee colony algorithm Glob optim (2007) 39;459-471, DOI 10.1007/s10898-007-9149-x.
12. Jagdish chand Bansal, Shimpy Singh jadon, Ritu Tiwari, Deep Kiran, B.K Panigrahi 2014. Optimal power flow using Artificial Bee colony algorithm with global & local neighbourhood DOI 10.1007/s13198-014-0321-7
13. Harish Sharma, Garima Hazrati, Jagdish chand Bansal in (2019). Spider Monkey Optimization Algorithm publish in springer cham.